Biological Evaluation
Spruce Budworm Infestation
Carson and Santa Fe National Forests and Adjacent Private Land
Northern New Mexico

- 1959 -

by D. A. Pierce
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INTRODUCTION

A biological evaluation was made of the spruce budworm infestations on the Carson and Santa Fe National Forests and adjacent private land, in northern New Mexico. The evaluation was made by D. A. Pierce and F. M. Yasinski, entomologists, assisted by G. E. Janssen and N. P. Will, biological aides, Rocky Mountain Forest and Range Experiment Station. The sampling for egg mass abundance was started August 17 and completed September 11, 1959. The boundaries of the infestations were delineated during the annual aerial insect survey in July by F. M. Yasinski.

Much of the mixed conifer forest presently infested was aerially treated with DDT for the control of the insect in 1955. The budworm population decreased and remained at a low level for two years. An increase in intensity of defoliation was noted during the aerial detection survey in 1958.

The findings of the present evaluation indicate a sizeable increase in the spruce budworm population in 1960.

TECHNICAL INFORMATION

Causal agent--Spruce budworm, Choristoneura fumiferana (Clem).

Host trees--Douglas-fir, Pseudotsuga mensiesii var. glauca Franco; white fir, Abies concolor; blue spruce, Picea pungens, Engelmann spruce, Picea engelmannii.

Type of Damage--Light to moderate defoliation of the host trees characterizes the infestation. Only a few areas are heavily or very heavily defoliated.

Environmental factors--No unusual environmental factors are known to be associated with the outbreak.

Extent and location of outbreak--The spruce budworm infestation covers approximately 620,000 acres of mixed conifer type in northern New Mexico as determined by aerial surveys (see map). Table 1 lists the acreage of infestation by defoliation. A larger scale map that shows the boundaries of the infestations with greater precision is available from the Forest Insect Laboratory, Rocky Mountain Forest and Range Experiment Station, P.O. Box 523, Albuquerque, New Mexico.

Table 1.--Acreage of spruce budworm infestations in Northern New Mexico by degree of defoliation.

Location	Acreage and degree of defoliation 1/				
	Light	Moderate	Heavy	Very heavy	Total
Carson N.F. and adjacent private land	407,080	37,060	4,000	640	448,780
Santa Fe N.F. and adjacent private land	62,500	87,200	21,440	---	171,140
Total	469,580	124,260	25,440	640	619,920

1/ The defoliation categories are as follows: Light, defoliation barely visible from the air; Moderate, top one-fourth of tree defoliated; Heavy, one-half of tree defoliated, top-killing in progress; Very heavy, three-fourths of tree defoliated, tree killing in progress.

METHODS

The biological evaluation was carried out as outlined in the work plan 1/. We are indebted to V. M. Carolin, Pacific Northwest Forest and Range Experiment Station for his instructions and advice.

Last instar larvae and pupae were collected from infested trees in late June and early July. Parasites were reared from this material and forwarded to the Division of Insect Identification, ARS, for determination of the species.

Headquarters for the egg mass survey were established at the Supervisor's Office, Carson National Forest in Taos, New Mexico. Branch samples were collected in the field and brought to this central point for close examination for egg masses. Three local girls employed at Grade GS-2 examined the foliage and collected and counted the egg masses. Only two girls worked the final week. Egg mass sampling was started on August 17 and completed on September 11, 1959.

Eighteen sampling points (see Table 2) were selected throughout the infestation area. Eight plots were selected from the eastern division of the Carson National Forest; 5 from the western division and adjacent private lands; and 5 from the western division of the Santa Fe National Forest and adjacent private lands. Plots on the Carson National Forest adjacent to the eastern division of the Santa Fe National Forest are representative of that area.

1/ Pierce, D. A. Biological evaluation of spruce budworm, Region 3. Work plan, 1959.

Each plot consisted of 5 dominant or co-dominant trees of the same species. Douglas-fir was sampled on all but the Brazos Box plot, where it was necessary to sample white fir.

The sample unit was the equivalent of one branch from each tree in a plot. The branch unit was derived by saving two branches from opposite sides of the tree, at mid-crown, and using the foliage from one-half of each branch for the sample.

Each sample was measured to obtain area of foliage. One hundred buds were examined at random on the sample branches from each plot to obtain the percentage of bud kill.

Defoliation estimates were made of the infestation by two men using field glasses to estimate defoliation by crown thirds on individual trees.

RESULTS

Based upon the examination of 210,289 square inches of foliage, the average number of egg masses per thousand square inches of foliage was 32 in 1959 and 6 in 1958, or a ratio of 5.4 (Table 2).

For individual plots, the number of new egg masses per thousand square inches of foliage ranged from 5 (where white fir was sampled) to 70; the number of old masses from 2 to 14. The ratio of new to old masses varied from 2.0 to 18.0.

Of the egg masses collected, 1.4 percent had been parasitized. The parasites are being reared and will be sent to the Division of Insect Identification.

Bud counts on defoliated trees in the plots revealed that 24 percent had failed to extend normally. For individual plots the range was from 7 to 47 percent. It was not always possible to attribute bud kill to budworm feeding.

Defoliation of individual trees generally was from 11 to 25 percent. The defoliation on several areas ranged from 75 to 90 percent.

DISCUSSION AND CONCLUSIONS

The ratio of 5.4 new to 1 old egg masses shows that the budworm population is increasing. Unless natural mortality factors become highly effective this coming winter and spring, the 1960 population of larvae will be up to 5 times that of 1959. The prospect is for a much greater loss of foliage than in any past year. The area of heavy and very heavy defoliation will be enlarged. In addition, boundaries of light defoliation will be extended.

The sample of the parasites of the late larval instars and the pupal stage of the 1959 generation was too small to make positive conclusions. Also, our knowledge of their effectiveness in the southern Rocky Mountains is very limited. The limited sample and observations do indicate a very low level of abundance and it is reasonably safe to conclude that little help can be expected from this group of parasites in 1960. This phase of the biological evaluation needs to be greatly expanded in 1960.

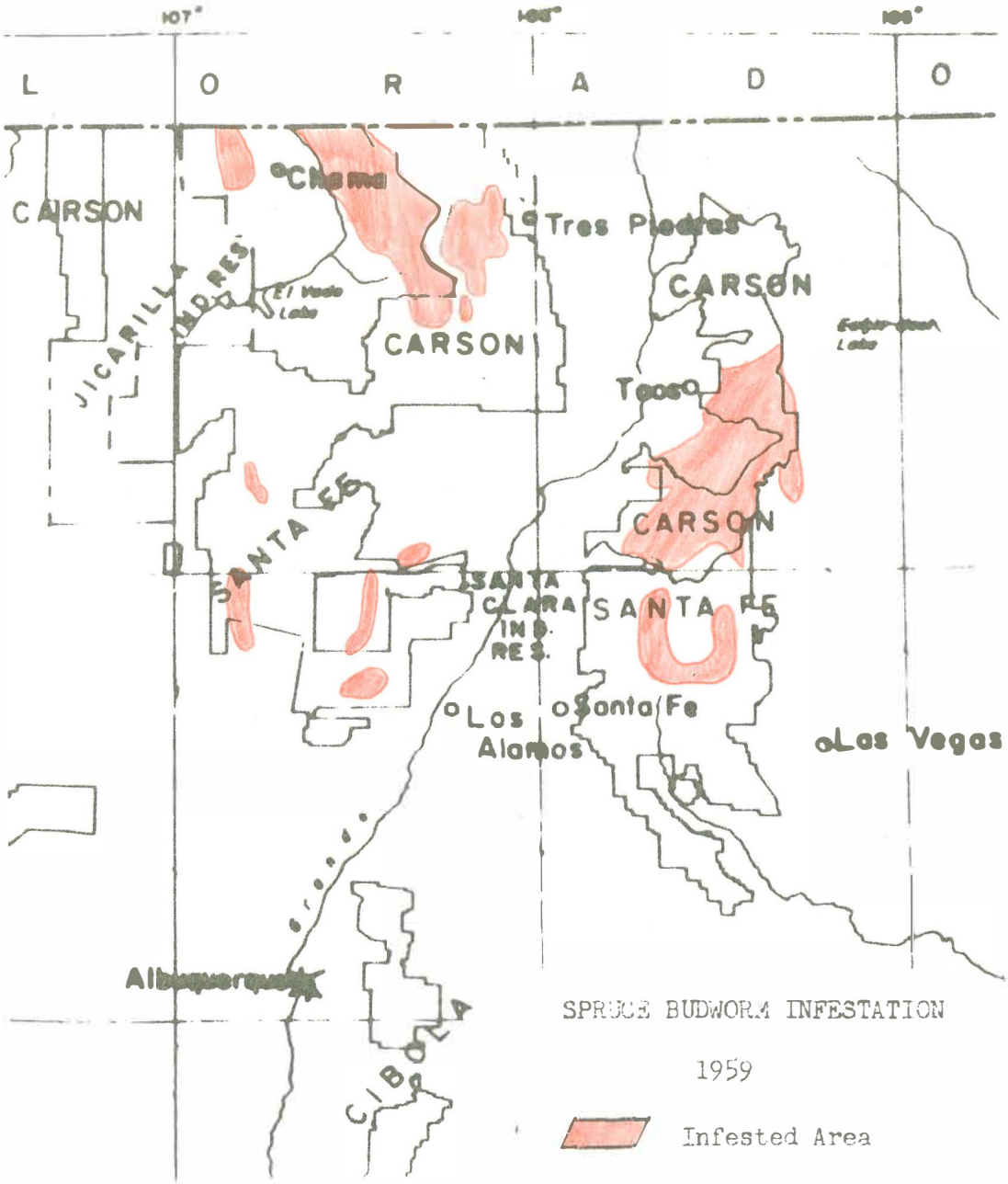
Similarly, the percentage of egg parasitism was low, 1.4 percent of the masses. This is not sufficient to have any significant effect upon the 1960 population of larvae.

On the brighter side of the spruce budworm picture is the data that shows an average bud kill of about 24 percent and loss of foliage between 11 and 25 percent through the greater part of the infestation. Trees have been killed only in the centers of the heavy and very heavy defoliation areas. Optimism in that regard should be tempered, however, by the knowledge that with each added degree of defoliation the Douglas-fir becomes more susceptible to attack by the Douglas-fir beetle. This bark beetle is already present in large numbers in most of the mixed-conifer type in the southern Rocky Mountains. This resident population with a large amount of susceptible host material could soon develop into a major epidemic and kill more Douglas-fir than the budworm outbreak alone.

The spruce budworm can be controlled in late larval instars by aerial application of DDT at a rate of 1 pound in 1 gallon of fuel oil per acre. Unfortunately much of the feeding by the generation being controlled has already taken place at the time the DDT is applied. Therefore, any control that is undertaken in 1960 should be done with the knowledge that much of the 1960 needle growth will be lost in spite of the project. Past experience with spruce budworm control in the Southwest shows that the larval mortality that can be effected with DDT is not equal to the uniform and near-perfect results experienced in the Pacific Northwest. This is believed to be from the more varied stage of development of the spruce budworm in the rough terrain in the Rocky Mountains. The application of DDT usually must be timed for average stage of development. This means that the application may be too late for maximum results at the lower elevations where some larvae have completed their feeding and too early for the higher elevations where some larvae are small, inside the bud and protected from the DDT.

Table 2.--Summary of Spruce Budworm Egg Mass Counts from 18 Plots on National Forests and adjacent land in Northern New Mexico--1959.

Plot location	Number of egg masses			Number of egg masses per thousand sq. in. of foliage		Ratio new mass to old
	New	Old	Parasitized	New	Old	
Carson N.F., Eastern Division and adjacent land						
Pot Creek	320	82	13	33	8	4:1
LaJunta Canyon	374	124	5	31	10	3:1
Comales Creek	402	53	10	42	5	8:4
Picuris Peak	581	36	2	54	3	18:0
LaJara Canyon	358	73	1	31	6	5:2
Pueblo Canyon	608	120	14	69	14	4:9
Taos Canyon	623	79	22	70	9	7:8
Chiquito Canyon	613	59	23	63	6	10:5
Subtotal	3,879	626	90	49	8	6:1
Carson N.F., Western Division						
Lobo Lodge	233	66	0	23	7	3:3
Brazos Box	73	30	0	5	2	2:5
Willow Creek	257	62	0	21	5	4:2
Canones Creek	181	49	1	14	7	2:0
Broke Off Mt.	278	28	0	29	3	9:7
Subtotal	1,022	235	1	18	5	3:6
Santa Fe N.F., Western Division and adjacent land						
Palisa Canyon	530	146	1	34	9	3:8
Del Norte Canyon	338	91	0	16	4	4:0
Clear Creek	186	68	0	18	7	2:6
Blue Bird Mesa	443	62	4	45	6	7:5
San Pedro Mts.	310	22	0	26	2	13:0
Subtotal	1,807	389	5	28	6	4:7
TOTAL	6,708	1,250	96	32	6	5:4


L O R A D O
CARSON
Chama
Tres Piedras
CARSON
JICARILLA INDIAN RES.
El Vado Lake
CARSON
Taos
Eagle Nest Lake
SANTA FE
CARSON
SANTA CLARA INDIAN RES.
SANTA FE
Los Alamos
Santa Fe
Las Vegas
Albuquerque
CIBOLA
SPRUCE BUDWORM INFESTATION
1959
Infested Area